SECTION 702 -- EXCAVATION FOR STRUCTURES

702.01 -- Description

1. a. Bridges and the steel/concrete structures specified in Division 700 may require excavation as part of their construction, and this excavation is distinguished from the roadway excavation specified in Section 200.

b. This work shall consist of all excavation for the following:

(1) Bridge foundations:

(i) Abutments.

(ii) Piers.

(iii) Bents.

(2) Concrete seals.

(3) All culverts.

(4) Structural plate pipe.

(5) Headwalls and wingwalls.

(6) Retaining walls.

(7) Steps.

(8) Other miscellaneous structures described in Division 700.

2. This work shall include the removal of any obstructions within the excavation limits shown in the plans. It shall include all necessary bailing, draining, pumping, sheathing, and the construction of cofferdams or temporary cribs and their subsequent removal. The work shall also include backfilling, compacting, and the disposal of any excess material obtained from such excavation.

702.02 -- Material Requirements

1. Backfill materials shall be approved by the Engineer.

2. "Granular Backfill" meeting the requirements specified in Subsection 1033.02, Paragraphs 1. and 2. and 3. or 6. and the requirements in Tables 1033.02A or 1033.06 is acceptable. "Clay lump" and "mortar-making" properties do not apply.

702.03 -- Construction Methods

1. Substructure Excavations:

a. The excavation limits are defined in the plans.

b. The Contractor shall excavate a volume large enough to contain the structure and its forms and provide access to set, strike, and inspect the forms (20 inch lateral spacing is generally adequate access).

c. (1) If water is encountered, the Contractor shall dewater the excavation.

(2) If unsuitable soil is encountered at the elevation established for the bottom of the excavation and if the soil does not become stable within a reasonable time after attempting dewatering, the excavation shall be continued to a width and depth designated by the Engineer and the additional volumes excavated shall be replaced with compacted granular material.

(3) The water level shall then be maintained at an elevation below the base of the excavation until after the concrete has been placed and set for at least 5 hours.

(4) If water percolates through the base of the excavation in spite of dewatering efforts, then:

(i) The Contractor shall place a watertight seal course in the bottom of the excavation.

(ii) This will be considered extra work.

(5) The Contractor shall prevent seepage through the cofferdam's walls. Such seepage shall not be justification for the placement of a watertight seal course except as noted in Paragraph 1.c.(3) of this Subsection.

d. (1) Spread footings which are supported by bed rock shall be founded on horizontal surfaces cut at least 6 inches into the rock.

(2) The entire bottom surface of the footing shall be in contact with the rock.

(3) (i) If the rock is not a hard, solid, and a continuous stratum, then the excavation shall be continued until rock which will furnish the required support is found.

(ii) If a satisfactory foundation is found more than 40 inches above, or if a satisfactory foundation is not found within 2 feet below the elevation shown in the plans, the work shall be suspended.

(iii) The Department will reevaluate the design before work resumes.

2. Excavating for Pipe and Pipe-Arch Culverts:

a. (1) The trench width at its bottom shall be at least 40 inches wider than the width of the pipe.

(2) All backfill will be placed as prescribed in Paragraph 3. of this Subsection.

(3) Bedding is shaping the trench to the pipe's diameter, including recesses for connections. It is required for all pipe with a diameter greater than 2 feet. Bedding shall include shaping the trench to not less than 10 percent of the total culvert height.

b. (1) When rock is encountered in the bottom of a culvert excavation, the rock shall be excavated to not less than 6 inches below the lower surface of the culvert and replaced with suitable, preferably granular, material.

(2) No part of a culvert shall rest directly in contact with rock.

c. Unsuitable soil encountered at the bottom of pipe trenches shall be excavated and replaced with approved granular material or crushed concrete meeting the gradation requirements of Subsection 702.02 paragraph 2.; the material shall be compacted to 95 percent of maximum density as determined by NDR T 99.

3. Backfilling:

a. All structures shall be backfilled in accordance with the following requirements:

(1) "Granular Backfill" limits are identified in the plans.

(2) Backfilling shall not damage any part of the structure.

(3) Approved materials shall be compacted to 95 percent of maximum density as determined by NDR T 99, or flowable fill may be used.

(4) Backfill for areas which provide support for any subsequent surface or base course, which includes the area directly below the pavement section of the bridge approach slab, shall be constructed in accordance with the requirements of Subsection 205.03 for Class III embankment and meet the compaction criteria in Table 702.01.

Table 702.01

Structure Backfill Requirements

	Depth Below	**Percent**		**Moisture Requirements**
Soil Type	**Finish Grade**	**Density**	**Minimum**	**Maximum**
Silt-Clay	Upper 40 in	96±3	Opt. -3%	Opt. +3%
Silt-Clay	Depths > 40 in	95 min.	**	Opt. +2%
Granular	All Depths	100 min.	**	**

** Moisture content as necessary to obtain density.

(5) (i) Soil shall be placed in layers approximately 6 inches thick.

(ii) Materials such as frozen soil, logs, stumps, sod, weeds, or other perishable matter shall not be used.

(iii) The Engineer may approve the use of large stones more than 12 inches in diameter if all voids between the large stones are filled with compacted soil.

(iv) Shales and other materials that break down during compaction shall be wasted.

(6) Backfilling shall not be started against any structure until test specimens of the concrete develop a strength of at least 2,000 psi in compression.

(7) Backfilling of retaining walls and abutments is limited to the top of berm elevation until the superstructure is in place.

(8) Backfilling culverts, abutments, wingwalls, and piers shall progress concurrently on all sides.

(9) All form boards or other obstructions shall be removed from drain or weep holes and any other structure before backfilling.

(10)(i) Underneath the approach slab sections excavated by the Contractor, the interior of all abutments and wingwalls and tie rod trenches shall be backfilled with granular backfill.

(ii) Granular backfill shall be compacted in accordance with Paragraphs 3. a. and 3. b. of this Subsection.

(iii) When tie rods are required, the abutment/wing backfill shall be placed and compacted to an elevation matching the planned tie rod elevations. The tie rods shall then be installed and the backfilling operation continued.

(iv) In lieu of excavating to construct the abutment substructure and then backfilling to the limits shown on the granular backfill detail, the Contractor may utilize other methods to achieve a minimum of 3 1/2 feet of clear excavation from the inside abutment/wing face.

(v) If this option is elected, the 3 1/2 feet wide void shall be backfilled with "Granular Backfill" from the bottom of the void to the bottom of the approach slab; and a minimum depth of 1 foot of granular backfill shall be placed and compacted under the remaining approach slab section.

(11)When the area to be backfilled has standing water, the area shall be drained or pumped until dry. If a suitable draining or pumping procedure cannot produce a dry area, an approved granular material may be deposited to an elevation above the water level.

(12)The Contractor shall use all available suitable backfill material before obtaining borrow (additional execution for backfill or embankment).

b. (1) The Contractor shall complete the backfill at bridges to the elevation shown in the plans. The backfilled surface shall be a smooth continuation of the surrounding ground.

(2) The Contractor shall compact backfill around bridge abutments, wingwalls, piers adjacent to railroad tracks, piers in the toe of embankment slopes, piers for grade separations, culverts, inlets, sewers, and all other structures shown in the plans.

(3) Tie rods shall be left in place during backfill operations.

(4) The volume to be compacted adjacent to bridges shall be the entire embankment between the faces of the abutment walls and vertical planes 10 feet outside and parallel to the ends of the floor.

(5) The entire area between the wings of box culverts and bridges shall be compacted.

(6) Abutments shall not be backfilled to the full height until the superstructure (except bridge slabs) has been placed.

c. (1) The Contractor shall place and compact embankments near pipe and box culverts in accordance with the requirements of Subsection 205.03 for the class of embankment and type of compaction shown in the plans.

(2) The area beneath and adjacent to pipe and pipe-arch culverts shall be backfilled carefully to insure the specified density is achieved.

(3) When the full embankment over a pipe culvert is not immediately placed, the embankment shall be constructed to the midpoint of the culvert's vertical height (or to the elevation of the widest dimension of a pipe-arch culvert), with berm tops 2 feet (0.6 m) wide and with 1 vertical to 2 horizontal slopes away from the culvert. When the full embankment over a box culvert is not immediately placed, the embankment around the foundations shall be backfilled to at least the elevation of the original surrounding ground surfaces, but no lower than the top of the foundations. If necessary, additional excavation for backfill or embankment may be required for this work.

(4) (i) When it is necessary or desirable to allow vehicles (construction or otherwise) to travel over a pipe or box culvert, the volume to be compacted adjacent to the pipe or box culvert shall be that between vertical planes located 10 feet outside of and parallel to the neat lines of the pipe or barrel at its maximum horizontal dimension. Compacted soil shall be placed to a depth at least 1 foot above the top of the box or pipe.

(ii) The volume of embankment needed to meet this requirement, less any separately placed to meet the requirements of Paragraph 702.03, 3.c.(3) shall be considered as ordinary embankment and included in the appropriate roadway grading quantities.

d. The Contractor shall protect backfill from washing away or other erosion until the contract is complete and accepted by the Engineer.

4. Excess Material Disposal:

a. The Contractor shall waste at the site or remove any excess material as approved by the Engineer.

b. No material shall be placed so as to permanently obstruct the flow of waterways except as shown in the plans.

702.04 -- Method of Measurement

1. a. Excavation for individual bridge piers, bents, and abutments is not a field measured quantity. The pay item is a Lump Sum.

b. Tie rod excavation is included in the bridge lump sum.

2. In the event that a bridge is constructed with a change in plans or with a change in the location, the payment may be recomputed.

3. a. Excavation for pipe culverts, headwalls, and box culverts is measured by the cubic yard.

b. The quantity of excavation is computed by the Department using the following limits described below:

(1) The upper limits will be the new channel section elevations, when shown in the plans, or the ground elevations, when a new channel section is not shown in the plans.

(2) The horizontal limits to be used in computing the quantity of excavation will be as follows:

(i) Concrete Footings. Vertical planes 20 inches outside of and parallel to the limits of the footings.

(ii) Headwalls. Vertical planes 20 inches outside of and parallel to the limits of the headwalls.

(iii) Pipe Culverts. Vertical planes parallel to the centerline of the pipe culverts separated by a distance equal to the nominal inside diameter of the pipe, plus 40 inches, and vertical planes 20 inches beyond the ends of the culvert.

(iv) Pipe-Arches. Vertical planes parallel to the centerline of the pipe-arch separated by a distance equal to the maximum nominal inside clear span dimension of the pipe-arch, plus 40 inches, and vertical planes 20 inches beyond the ends of the culvert.

(3) The lower limits to be used in computing the quantity of excavation will be as follows:

(i) Concrete Footings. The bottom of the footings or to the lower limits of unsuitable material removed at the direction of the Engineer.

(ii) Headwalls. The bottom of the headwalls.

(iii) Pipe and Pipe-Arch Culverts. The flowline elevation of the culvert, or to the lower limits of unsuitable material removed at the direction of the Engineer.

(4) In addition to the above, the nominal volume, based on neat dimensions, for the portion of the curtain or cutoff wall below the bottom of the concrete footings will also be included for payment for box culvert excavation.

(5) (i) Overlapping excavation volumes will be measured and deducted from the pay volumes so that a volume is only paid for once.

(ii) The overlap of a pipe removal excavation volume with an excavation volume required to construct new work will be deducted by subtracting the overlapping pipe removal excavation volume from the new work excavation volume.

(6) The excavation associated with the preparation of a structure or the removal of a structure shall be included in the quantity of excavation for pipe culverts and headwalls or excavation for box culverts when the structure is within the limits of excavation for the culvert or its headwalls.

(7) Deductions will be made for the volume of any intersecting structure, except for pipe or pipe-arch culverts when the intersecting structure has a cross sectioned area of more than 21.5 square feet within the limits of culvert excavation.

(8) (i) When excavation depths exceed 4 feet, an additional horizontal allowance will be computed on the basis of Figure 701.01.

(ii) The slope of trench walls shall be approximately 1.0 foot rise to 1.0 foot run.

c. The excavation limits may vary due to the bedding requirements shown in the plans, however, the quantity of excavation will be computed on the basis of Figure 701.01.

4. When the plans or special provisions require a culvert to be built with shoring or sheet piling, then figure 701.01 will be superseded by the location of the shoring and the sheet piling when determining the authorized volume of excavation for culverts and pipes.

5. a. When additional material is required for backfilling or for the construction of embankments as prescribed in these *Specifications*, the quantity to be paid for will be the volume of the material actually removed measured in cubic yards in its original position.

b. When it is impracticable to measure the volume of material actually removed in its original position, the quantity to be paid will be 1.4 times the volume of placed embankment (cubic yards). Payment will not be made for any surplus material placed outside the specified limits.

6. a. "Granular Backfill" for bridges shall be the quantity shown in the plans.

b. The quantity for "Granular Backfill" shown in the plans is computed in cubic yards based on the lines and grades shown in the "Granular Backfill" details. In the event that a bridge is constructed with a change in plans or with a change in the location, the payment may be redetermined.

c. Deductions will not be made in the quantity of "Granular Backfill" when the Contractor elects to use a sheet pile wall to construct the abutment substructure in lieu of excavation.

d. When it is necessary to remove unsuitable material or unforeseen obstacles at the direction of the Engineer and additional granular backfill is required, the removal and the additional "Granular Backfill" will be paid for as "extra work."

7. Seal course concrete is a negotiated item that is not shown as a bid item but may be necessary to stop unforeseen water intrusion.

8. a. Backfill required by paragraph 3.c.(3) of Subsection 702.03 to build the berm and the 1 vertical to 2 horizontal slopes is measured and paid for as “Excavation for Pipe, Pipe-Arch Culverts and Headwalls” or “Excavation for Box Culverts”.

b. Backfill beyond the berm limits in paragraph 3.c.(3) of Subsection 702.03 is paid for under the pay item for the remainder of the surrounding embankment.

702.05 -- Basis of Payment

1. **Pay Item** — **Pay Unit**

Abutment _____ Excavation	Lump Sum (LS)
Pier _____ Excavation	Lump Sum (LS)
Bent _____ Excavation	Lump Sum (LS)
Granular Backfill	Cubic Yard (CY)
Excavation for Pipe, Pipe-Arch Culverts, and Headwalls	Cubic Yard (CY)
Sheet Pile Excavation	Cubic Yard (CY)
Seal Course Concrete	Cubic Yard (CY)
Excavation for Box Culverts	Cubic Yard (CY)

2. a. The bridge plan quantities will be recomputed when:

   (1) Structure length increases or decreases by more than 10 feet.

   (2) The structure location changes by 10 feet in any plane.

   (3) The width of the structure changes.

   (4) Structures are added or deleted.

   (5) A structure skew angle changes by more than 10 degrees.

b. No direct payment will be made for furnishing, placing, and removing cofferdams or cribs. This work shall be considered subsidiary to the item requiring the cofferdam or crib.

c. Additional work required due to unforeseen obstacles which are essentially man-made in character, unknown to both the Department and the Contractor at the time of receiving bids, and which, in the opinion of the Engineer, will be detrimental to the work of Excavation for Structures shall be "extra work", except as noted in Subsection 104.06.

d. Removal of obstacles or obstructions that are unforeseen shall be paid for as "extra work", except as noted in Subsection 104.06.

e. Direct payment will not be made for the following work which shall be considered as being subsidiary to the associated structure pay item:

   (1) Stepping slopes.

   (2) Placing or removing cofferdams and cribs.

   (3) Backfilling or compacting.

   (4) Water used to facilitate compaction.

   (5) Drainage provisions at drains or weep holes.

   (6) The work involved in "bedding" pipes in trenches.

   (7) Sheeting and shoring.

(8) Gravel, crushed rock, or other fill material (except as allowed in Paragraph 5. of this Subsection).

3. a. Box and pipe culvert excavation shall be the quantity shown in the plans.

b. The quantity will be recomputed when the completed structure differs from the plans because of one or more of the following changed conditions:

(1) An increase or decrease in length of more than 10 feet.

(2) A change in location, measured along the centerline of the project, of more than 10 feet.

(3) A change in flow line elevation, at one or both ends of the structure, of more than 1 foot.

(4) An addition or deletion of any horizontal or vertical bend.

(5) A change in the skew angle of more than 10 degrees.

c. If the Engineer and the Contractor agree, in writing, that no significant change in excavation has resulted from the occurrence of one or more of the conditions listed in Paragraph 2.b. of this Subsection, then the quantity of excavation need not be recomputed.

4. Direct payment will not be made for any excavation required in connection with the construction of pipe culverts, median inlets, and flared-end sections or other appurtenances which are a part of the median culvert items shown in the plans. This work shall be considered subsidiary to the items for which the contract provides that direct payment will be made.

5. a. Additional excavation for backfill and embankment for pipe culverts, headwalls, and box culverts will be paid at the item's contract unit price -- "Excavation for Pipe or Pipe-Arch Culverts and Headwalls" and "Excavation for Box Culverts".

b. Embankment placed above the limits specified in Subsection 702.03, Paragraph 3.c.(4) shall be included with appropriate earthwork pay item ["Excavation", "Excavation Borrow", "Excavation (Established Quantities)", or "Earthwork Measured in Embankment"].

c. When "Earthwork Measured in Embankment" is the appropriate pay item, the volume of an "Additional Excavation for Backfill" shall be deducted from the "Earthwork Measured in Embankment" quantity.

6. a. When gravel or crushed rock is placed for a structure foundation as "extra work" at the direction of the Engineer, payment will be based on 10 percent of the contract unit price for "Box Culvert Concrete".

b. If "Box Culvert Concrete" is not a pay item, then the NDR average unit price for "Box Culvert Concrete" will be used.

c. Gravel or crushed rock will not be paid for as “extra work” when placed at the bottom of a foundation if the material is not required structurally and is being provided solely as a good working platform for the Contractor. However, if the material is needed to properly seat forms or for some other structural reason, then payment is authorized.

7. a. When it is necessary to lower the elevations of bridge foundation beds, the additional excavation will be measured for payment as "extra work".

b. Excavation for a seal course is subsidiary to seal course concrete.

c. The quantities of unsuitable material excavated beyond the excavation limits shown in the plans and removed at the direction of the Engineer will be paid as "extra work."

8. Deductions will not be made in the price paid for excavation when satisfactory foundation beds for spread footings are found at elevations within 40 inches above the elevations shown in the plans; however, when it is necessary to lower the elevations of these foundation beds or to remove unsuitable material as directed by the Engineer, the additional excavation will be paid for as "extra work".

9. Payment is full compensation for all work prescribed in this Section.